

Failure of AMSU-A Channel 4 and Degradation of AMSU-A Channel 5 NeDT Affecting AIRS Retrieval Performance

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Summary: AMSU-A Channels 4 and 5 have significantly degraded since launch. This has affected the yield and quality of retrieved AIRS geophysical products since 2007. The drop off in yield accelerated in 2011 commensurate with the rapid degradation in AMSU-A Channel 5. Version 6, the upcoming update of AIRS Science Processing software, does not use either AMSU-A Channels 4 or 5, and will result in improved yields overall. Version 6 is planned to be released in late 2012.

Degradation of AMSU-A Channel 4 began impacting the yield of the operational Version 5 AIRS/AMSU-A retrieval products in October 2007, especially near the surface. In response to this degradation, the AIRS Project and the GES DISC began producing IR-Only products on November 8, 2007. They are available via WHOM and Mirador data ordering tools at http://disc.sci.gsfc.nasa.gov/AIRS/data_products.shtml. The AIRS project made changes to the V5 retrieval algorithm to accommodate the degraded AMSU-A Channel 4. More details are in http://disc.sci.gsfc.nasa.gov/AIRS/documentation/v5_docs/AIRS_V5_Release_User_Docs/V5-Modification-for-AMSU-Ch-4-NeDT.pdf.

Note that the Version 5 IR-Only algorithm has not been exhaustively validated, but initial comparisons of its products with those of the AIRS+AMSU algorithm are in the Version 5 Test Report as part of the Version 5 Data Release Documentation. See the AIRS document http://disc.gsfc.nasa.gov/AIRS/documentation/v5_docs/AIRS_V5_Release_User_Docs/V5_Test_Report.pdf for additional discussion. The IR-Only algorithm has a slightly lower yield than the combined AIRS/AMSU algorithm, due to its reduced capability to handle very cloudy fields of view. This is discussed in more detail in the AIRS documents <http://disc.sci.gsfc.nasa.gov/AIRS/documentation/notices/AMSU-A-Channel-4-NeDT-Update-2007-12-20.pdf> and http://daac.gsfc.nasa.gov/AIRS/amsu_ch4_noise_increase.shtml

In addition to the degradation of Channel 4, AMSU-A Channel 5 estimated noise equivalent brightness temperature (NeDT) has been increasing rapidly since 2010. It exceeded 1 K in early 2011, 2 K in early 2012, and continues to increase (Figure 1). The loss of AMSU-A Channel 5 is significantly impacting the yield of the operational Version 5 combined AIRS/AMSU retrieval products in the lower troposphere where AMSU-A Channel 5 peaks. Daily global yields are a good indicator of this situation, and they have dropped rapidly since early 2010 (Figure 2), commensurate with the increase in AMSU-A Channel 5 NeDT. The slower decline in yield since launch reflects the early, slow degradation of AMSU-A Channel 5. The Version 5 data set has an unrelated long slow degradation that is probably linked to increases in atmospheric CO₂ and

N₂O; the Version 5 algorithm uses a first-step regression solution with assumed constant CO₂ and N₂O amounts. Figure 2 also shows the yields of the Infrared-Only retrievals since 2010. As mentioned above, average IR-only yields are slightly lower due to cloud effects. However, Figure 2 shows that IR-only yields are now higher than yields for the combined AIRS/AMSU-A Version 5 algorithm.

The GES DISC is currently archiving AIRS data products generated with retrieval algorithms using combined AIRS/AMSU/HSB radiances, combined AIRS/AMSU radiances, and the AIRS infrared radiances alone (IR-Only). The full set of available products is described at http://disc.sci.gsfc.nasa.gov/AIRS/data-holdings/by-data-product/data_products.shtml. The naming convention for the different Level 2 products is shown in Table 1.

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AIRS Standard Retrieval Products (Level 2)	Data Product Short Name	Data Product Collection Notes:
AIRS/AMSU/HSB Retrieved Products	AIRH2RET	Products available from September 2002 – January 2003. (HSB ceased to operate in January 2003.)
AIRS/AMSU Retrieved Products (no HSB)	AIRX2RET	Products available from September 2002 – present.
AIRS IR-Only Retrieved Products (no AMSU/HSB)	AIRS2RET	Data coverage: November 2007 – present.

Table 1. Naming convention for Level 2 retrievals using AIRS, AMSU and HSB Level 1 radiance combinations.

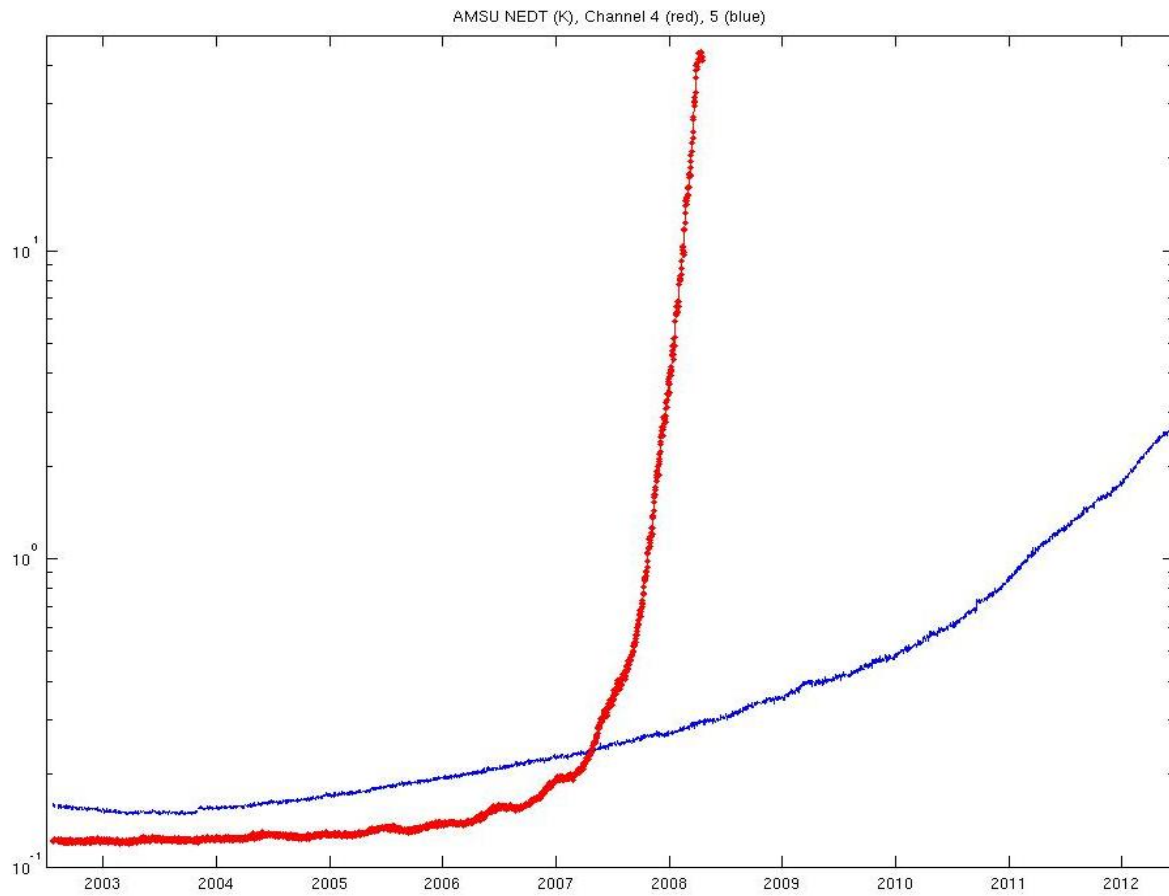


Figure 1. Time series of estimated Ned for AMSU-A Channel 4 (red) and Channel 5 (blue).

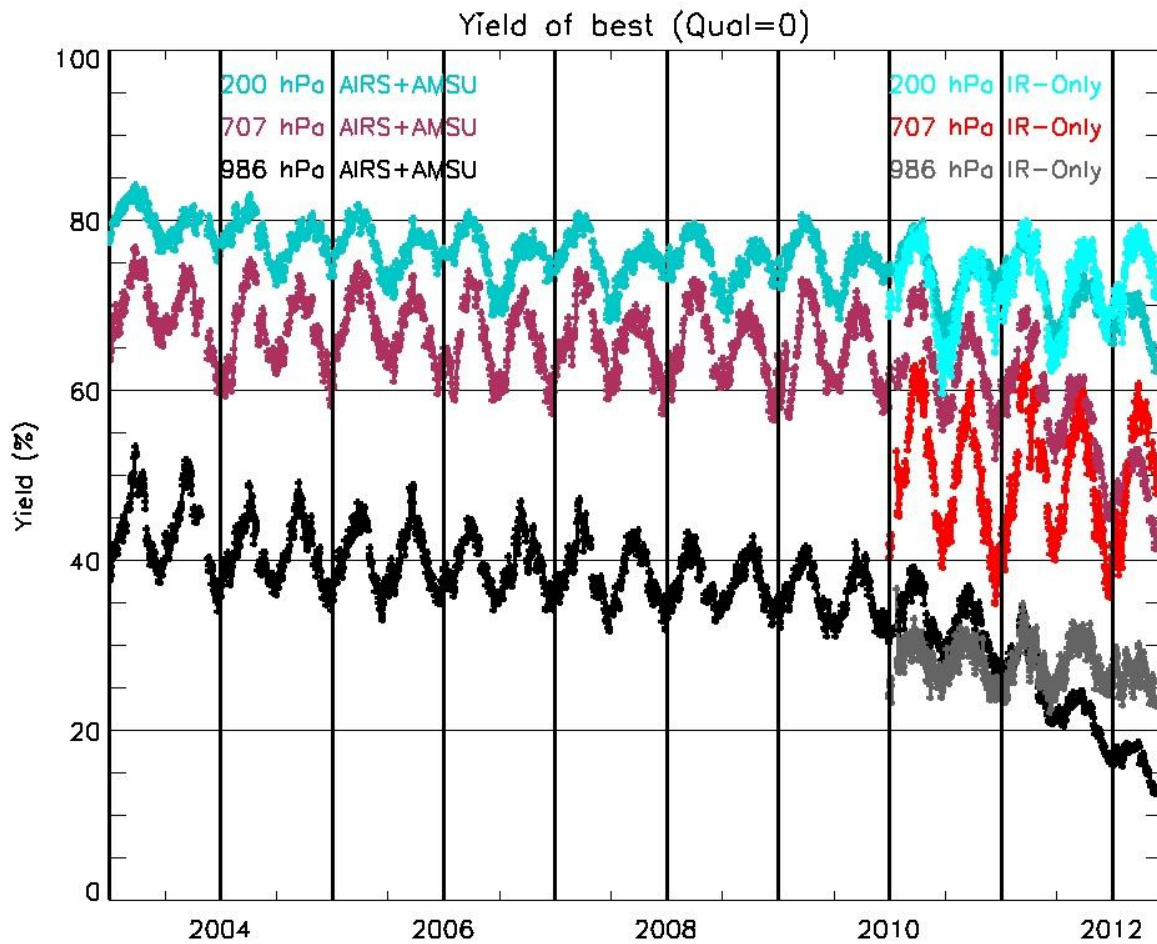


Figure 2. Yields of combined AIRS/AMSU-A retrievals, and Infrared-Only retrievals.